DSH, Datasheet

ZM1206 Z-Wave Module

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REVISION RECORD

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01.01	February 12, 2003	JFP	ALL	“SFF Z-Wave” replaced by “ZM1206”.
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01.05	November 9, 2004	TJO	10, 13, 14	Section 4.7 added Table 7 updated with reset signal requirements Section 4.15 added

Table of Contents

1 ABBREVIATIONS

Abbreviation	Explanation
ADC	Analog-to-Digital Converter
API	Application Programming Interface
FSK	Frequency Shift Keying
GPIO	General Purpose Input/Output
HW	Hardware
I/O	Input/Output
LSB	Least Significant Bit
MCU	Micro Controller Unit
MSB	Most Significant Bit
OEM	Original Equipment Manufacturer
PCB	Printed Circuit Board
POR	Power On Reset
RF	Radio Frequency
RTC	Real-Time-Clock
RX	Receive
SPI	Serial Peripheral Interface
SRAM	Static Random Access Memory
SRD	Short Range Devices
SW	Software
TX	Transmit
UART	Universal Asynchronous Receive Transmit
ZM1206	6 cm^2 Z-Wave Module based on the ZW0102 Single Chip
ZM1220	20 cm^2 Z-Wave Module based on the ZW0102 Single Chip
ZW0102	Z-Wave Single Chip

2 INTRODUCTION

2.1 Purpose

The purpose of this document is to present the technical specifications for the Z-Wave Module, which is based on Zensys' Z-Wave ZW0102 Single Chip [1]. The ZM1206 Z-Wave Module is available in a US version (908.42MHz) and in a EU version (868.42MHz), which both are described in this datasheet.

2.2 Audience and Prerequisites

The audience of this document is R&D external readers. No prerequisites required.

3 PRODUCT DESCRIPTION

3.1 Overview

The ZM1206 Z-Wave Module is a central part of Zensys' range of generic Z-Wave Modules and is based on Zensys' Z-Wave ZW0102 Single Chip. The ZW0102 Single Chip contains a RF transceiver, an 8051 micro-controller, a flash memory and a wide range of HW interfaces. The ZM1206 Z-Wave Module contains all the necessary hardware (HW) and software (SW) needed for Z-Wave Protocol handling, RF transmission/reception and Application Programming Interface (API).

The ZM1206 Z-Wave Module can be used for designing both Z-Wave Slave Nodes and Z-Wave Controller Nodes. A Z-Wave Slave Node is capable of executing commands requested by a Z-Wave Controller Node. A Z-Wave Controller Node is capable of initiating commands, creating routing tables etc., e.g. functions as a remote control. For more node type information see [4].

The ZM1206 Z-Wave Module contains the ZW0102 Single Chip with integrated flash and SRAM. Additionally the Module contains an RF front-end. It has double side component mounting. Moreover the Module has mounting option for Real-Time-Clock crystal and EEPROM on the bottom side.

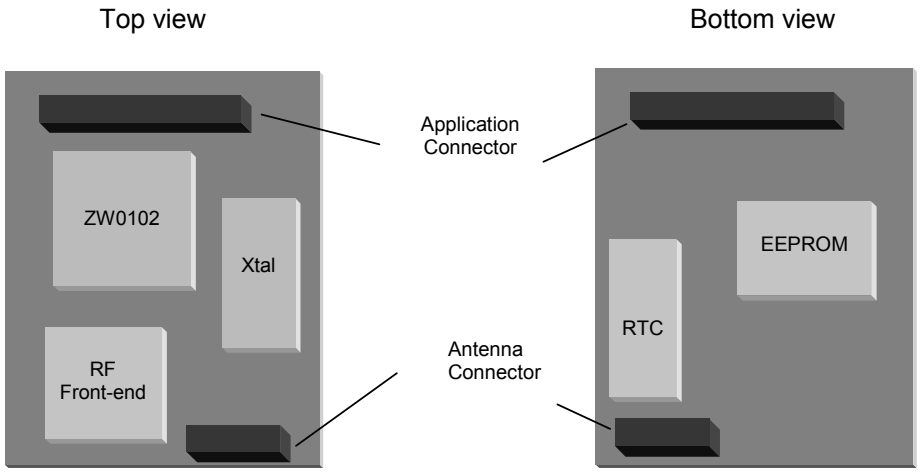


Figure 1 ZM1206 Z-Wave Module

An Application Module can be connected to the ZM1206 Z-Wave Module through an Application Connector (see Figure 1)

The Application Connector contains multiple user programmable General Purpose I/O's (GPIO's) for interconnection with a wide range of Application Modules. The Application Connector on the ZM1206 Z-Wave Module is not pin-out compatible with the Application Connector on the ZM1220 Z-Wave Module [8] model with integrated PCB antenna. To enable compatibility, a ZM1206 Converter Module [6] is needed. On the ZM1206 Z-Wave Module, an antenna connector is present with which a PCB or a Whip antenna or similar must be used. An antenna is then required on the Application Module.

The RF data rate is 9600bps, and the carrier frequency is 868.42 MHz (EU) or 908.42 MHz (US). Frequency Shift Keying (FSK) is used as modulation type.

The Application Connector interfacing the ZM1206 Z-Wave Module with an Application Module is a 2.00mm pitch 2x8 pin-row. The Application Connector contains the following signals:

- 10 General Purpose I/O pins (9 with dual functionality)
- One interrupt input pin
- Serial UART interface
- SPI interface (Serial Peripheral Interface)
- One ADC input
- Zero Crossing Detection input (used for dimmer applications)
- TRIAC control output (used for dimmer applications)
- Reset input
- 3.3V power input
- Two Ground

Some of the GPIO's have a dual functionality meaning they support "special" signals (interrupt, SPI etc.) see Table 2. All signals on the Application Connector are 3.3V CMOS signaling compatible, and are all controlled by the application SW.

The software modules handling the Z-Wave Protocol and RF transmission are part of the ZM1206 Z-Wave Module. OEM application software can be added to the Z-Wave Protocol software via a well-defined Application Programming Interface (API). Different API's are available to support different kind of application, see [5] for further information. Note that some API's do not support all the above-mentioned interfaces, please check [5].

In the following chapter the HW specifications for the ZM1206 Z-Wave Module is described. The specifications for the ZW0102 Single Chip will not be described within this datasheet but can be found in [1].

4 HW SPECIFICATIONS

4.1 Application Connector Specification

The Application Connector interfacing the ZM1206 Z-Wave Module with the Application Module is a 2x8 pin row.

Pin No.	Pin Name	Pin Name	Pin No.
1	GND	+3.3V	2
3	TRIAC	CLK	4
5	ZEROX	MOSI	6
7	TXD	IO9	8
9	RXD	INT0_N	10
11	PWM2	AD2	12
13	PROG_N	MISO	14
15	GND	RESET_N	16

Table 1 ZM1206 Z-Wave Module Application Connector Layout

Name	I/O	Description
+3.3V	Power	Module 3.3V supply input.
AD2	I	Analog-to-Digital converter input. The ADC is 10 bit and can use either Vcc or an internal voltage as reference.
CLK	I/O	SPI Clock: Can be used as master SPI clock signal or GPIO signal. Clock input for Flash programming
GND	Power	Ground.
INT0_N	I/O	Interrupt: Active low external interrupt signal. The signal is level or edge trigged. When in power down mode, the ZM1206 Z-Wave Module's MCU is woken up by activating this interrupt signal. Can also be used as GPIO pin.
IO9	I/O	In/Out: General purpose I/O signal.
MISO	I/O	Master In Slave Out SPI interface: SPI data output used for Flash programming. Can in normal operation be used as MISO signal or as GPIO signal.
MOSI	I/O	Master Out Slave In SPI interface: Can in normal operation be used as MOSI signal or as GPIO signal. SPI data input used during Flash programming.
PROG_N	I	Program Enable: Active low flash programming signal. The pin cannot be used after programming. For Programming instruction, see [5].
PWM2	I/O	Pulse Width Modulator Output: Used for frequency variation applications. Can be used as GPIO signal.
RESET_N	I/O	Reset: Active low ZM1206 Z-Wave Module's reset. The ZW0102 Single Chip has an integrated Power On Reset circuitry.
RXD	I/O	UART Receive Data: Supports 2.4kbps – 115kbps. Can be used as GPIO pin.
TRIAC	I/O	TRIAC Control: A triac controller is implemented in the ZW0102 Single Chip that can controls a triac on the Application Module like light dimmer modules etc. Can be used as GPIO signal.
TXD	I/O	UART Transmit Data: Supports 2.4kbps – 115kbps. Can be used as GPIO pin.
ZEROX	I/O	Zero Cross Detection: Zero cross detection signal used on dimmer modules detecting 120/240V zero crossing. Can be used as GPIO signal.

Table 2 Application Connector Signal Description

Note: some API's do not support all the above-mentioned interfaces, please see [5].

4.2 Application Connector Signals

4.2.1 GPIO Pins

Some of the signals, which have a special function, can also be used as General Purpose Inputs/Outputs pins (GPIO) if wanted. All GPIO signals have true Read-Modify-Write functionality when used as general digital I/O ports. The “special” purpose signals, which can be used as GPIO are listed in the following table.

- INT0_N
- TXD
- RXD
- MOSI
- MISO
- CLK
- TRIAC
- XEROX
- PWM2

For electrical characteristics see section 4.13.

4.2.2 UART

The ZM1206 Z-Wave Module features a full duplex Universal Asynchronous Receiver and Transmitter (UART), which enables real time control of the ZM1206 Z-Wave Module, either by a CPU on the Application Module or by a PC, requiring a RS232 driver on the Application Module. The interface supports the following features:

- Data rate: 2.4kbps – 115kbps (default 9.6kbps)
- 8 bits per word
- One Stop bit
- No parity
- 3.3V signaling

When powering up the ZM1206 Z-Wave Module for the first time, the data rate of the serial interface is 9.6kbps, and can afterward be changed to the desired data rate.

4.2.3 SPI Interface

The Serial Peripheral Interface (SPI) allows high-speed synchronous data transfer between the ZM1206 Z-Wave Module and the Application Module. The ZM1206 Z-Wave Module SPI includes the following features:

• Full-duplex, 3-wire Synchronous Data Transfer
• Master Operation
• LSB First or MSB First Data Transfer
• Four Programmable Bit Rates in Master Mode (f_{sys} /8, f_{sys} /16, f_{sys} /32 or f_{sys}/64)

The signals MISO, MOSI and CLK on the Application Connector are used. For SPI timing characteristics see[1]. The SPI controller does not support Slave in normal operation mode, only in flash programming mode. If Slave operation is needed it can be implemented in SW using three GPIO pins.

4.2.4 Analog-to-Digital Converter

The Analog-to-Digital Converter (ADC) input (AD2) is a 10-bit type. An internal (ZW0102) voltage reference or the supply voltage Vcc can be used as reference. For detailed description and electrical specifications, see [1]

4.2.5 TRIAC & ZEROX

The ZM1206 Z-Wave Module has a triac control output signal (TRIAC) with 8mA drive. Using the ZEROX detection input signal, a “fire pulse” is generated on the TRIAC signal to trigger the triac on the Application Module. Zensys A/S has developed a 300W dimmer outlet including the ZM1206 Z-Wave Module as well as Dimmer Application Module and SW. Contact Zensys for further information.

4.2.6 Pulse Width Modulator Output

The Pulse Width Modulator Output (PWM2) is controlled by an internal 16-bit Timer/Counter. The prescaling of the Timer/Counter is:

- CLK : 7.376974 MHz
- CLK/2 : 3.688487 MHz
- CLK/4 : 1.844244 MHz
- CLK/8 : 922.1218 kHz
- CLK/16 : 461.0609 kHz
- CLK/32 : 230.5304 kHz
- CLK/64 : 115.2652 kHz
- CLK/128 : 57.63261 kHz
- CLK/256 : 28.81630 kHz

Where CLK is the system frequency determined by the crystal frequency (7.376974 MHz). The PWM2 output can also be used as GPIO.

4.3 Real-Time-Clock

A RTC crystal can be mounted for real-time application like hour/minute/second indication. A typical application could be remote controls or battery operated slaves that need to be powered down and woken up at certain time intervals.

4.4 EEPROM

The ZM1206 Z-Wave Module has mounting option for an external onboard EEPROM used for data storage. When used as Z-Wave Controller Node, the EPPROM is used for routing table storage. IO10 signal is used for EEPROM Chip Select. Note that a Pull Up Resistor is present on the EEPROM Chip Select signal, and that the production test can be achieved by pulling down Chip Select (See [7]). Up to 256kbit EEPROM can be mounted, see [2] or [3] for further details.

4.5 Reset

The ZM1206 Z-Wave Module can be reset either by the integrated Power-On-Reset circuitry (with Brown-out detection) in the ZW0102 Single Chip when the ‘+3.3V’ pin is under 2.9V or by the Application Module via the Application Connector signal RESET_N. The reset signal must have rise and fall time of less than 400uSec (seeTable 7).

4.6 Power

The ZM1206 Z-Wave Module must be powered with 3.3V by the Application Module. For supply voltage requirements see table 7.

4.7 EMC

As default two 330@100MHz Ferrite Beads (Murata BLM21AG331SN1D) are mounted between the Application Connector ground and module ground (L413 and L415, see Figure 2) and also between the Application Connector VCC and module VCC (L409) to filter noise from the Application Circuitry. This mounting option is good for lower power digital circuitries like battery-operated products. In high power products like dimmer products etc. high current noise may generate a noise-voltage over the ground Ferrite Beads (L413 and L415). It is therefore recommended to replace the Ferrite Beads with two zero ohm resistors in these kind of products.

For schematic see for example [9] or [10].

4.8 RF

4.8.1 RF input/output

The ZM1206 Z-Wave Module is equipped with a SAW filter that rejects the unwanted frequencies both in receive and transmit operations. When the ZM1206 Z-Wave Module is using an antenna placed on the Application Module, the matching of the SAW filter and the external antenna takes place on the Application Module.

4.8.2 Antenna

In order to implement the ZM1206 Z-Wave Module in various products, different types of antennas can be implemented to get the best RF performance, i.e. range and reliability. The ZM1206 Z-Wave Module is equipped with a connector footprint where a wire antenna can directly be fixed.

If another antenna type is chosen, such as a PCB antenna or a whip antenna using a SMA connector, it has to be implanted on the Application Module. The connection between the ZM1206 Z-Wave Module and the Antenna is done via a 2mm pitch pin row. A ZM1206 Converter Module (see[6]) developed by Zensys can, during prototype development, be used as an Antenna Module as it contains both a PCB Antenna and a SMA connector, which allow the use of a Whip antenna.

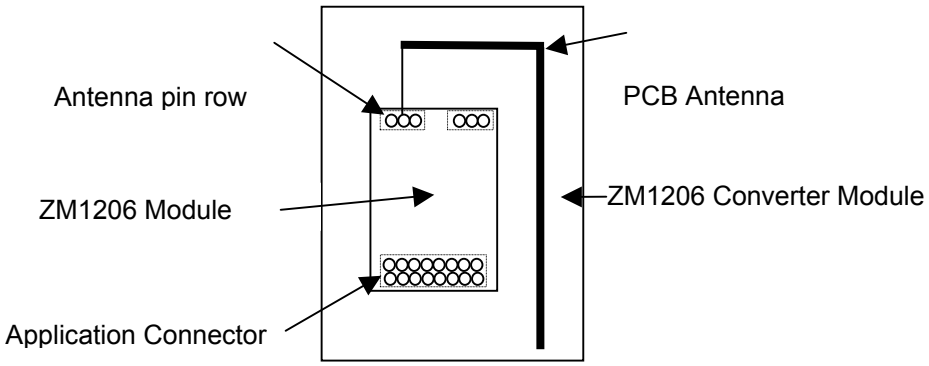


Figure 2: ZM1206 Z-Wave Module connected PCB antenna via Antenna Module

See [8] for implementation guideline of the ZM1206 Z-Wave Module.

4.9 Z-Wave Module Programming

The ZM1206 Z-Wave Module is programmed using the SPI interface, RESET_N and the program enable signal PROG_N. For programming instruction and recommended programming tool(s) see [5].

4.10 MCU Specification

MCU	Description
MCU Type	Optimized 8-bit 8051 MCU core (4 clock cycles per instruction), See [1].
MCU speed	7.376974 MHz
Flash	32kbyte. Programmed through the SPI interface.
SRAM	2kbyte
SRAM (CPU)	128 byte
MCU Peripherals	10-bit ADC, UART, SPI, 8 bit timer, 2x16 bit timer one with PWM mode, watch dog timer, Power-on Reset/Brown-Out Detector.
Interrupt sources	Internal and external.

Table 3 MCU Specifications

4.11 ZW0102 Single Chip Peripherals

Peripherals	Description
Crystals	System Clock: 7.376974 MHz, ±8ppm@25°C, ±8ppm@-10°C to +85°C, 3ppm aging per year. Real-Time Clock: 32.768kHz
Optional Peripherals	EEPROM and RTC crystal

Table 4 MCU external peripherals

4.12 RF Specification

RF	Description
RF Data rate	9.6 kbps
RF frequency (center frequency)	868.42 MHz Model 7048 908.42 MHz Model 7047
Modulation	Frequency Shift Keying (FSK)
Frequency deviation	Center frequency ± 20kHz
Signal coding	Manchester Encoded
RF filter	SAW Filter US: Center frequency = 902MHz, BW = 25MHz EU: Center frequency = 860.5MHz, BW = 19MHz
Selectivity	@ 100kHz: 4dBc @ 1MHz: 38dBc @ 2MHz: 48dBc >30 MHz: 83dBc
Typical RF receiver sensitivity	-95dBm
ZW0102 RF Output Power	-20dBm to 4dBm
Typical RF output power	Optimized for (Wire antenna): US: FCC Part 15 EU: ERC 70-03 on SRD
Range (typical)	Indoor >30 meters line of sight, in unobstructed environment. Outdoor > 60 meters line of sight
RF regulatory	US: R&TTE Directive 1999/5/EC, EN 300 220-3/2000 EU: FCC Part 15

Table 5 RF Specifications

4.13 Electrical Specification

The “Absolute Maximum Ratings” specifies the conditions in which the ZM1206 Z-Wave Module is guaranteed not to be damaged but correct operations are not guaranteed. Exceeding the “Absolute Maximum Ratings” may destroy the ZM1206 Z-Wave Module. See “DC Characteristics” for guaranteed operation limits.

4.13.1 Absolute Maximum Ratings

Electrical	Value
Operating Temperature	-30°C to +100°C
Storage Temperature	-40°C to +105°C
Voltage on input pins	-0.3V to V_{CC}+0.3V (5V max)
Minimum Operating Voltage (Vcc)	-0.3V
Maximum Operating Voltage (Vcc)	5V
DC Current per GPIO Pin	±4mA

Table 6 Absolute Maximum Ratings

4.13.2 DC Characteristics

The following DC characteristics are for the ZM1206 Z-Wave Module. DC characteristics related to the ZW0102 Single Chip are to be found in [1] and are not listed in this datasheet.

T_A = 25°C, Vcc = 3.3V (unless otherwise noted)

Symbol	Parameter	Condition	Min	Typ	Max	Units
Vcc	Main Supply voltage(1)	(Max. 20mVpp ripple from DC to 300kHz)	2.7	3.3	3.6	V
RRST	Reset Pull-up Resistor	Integrated in ZW0102	48		60	kΩ
R_{AC}	Application Connector Serial Resistor	All signals except TRIAC	0.9	1.0	1.1	KΩ
$R_{AC, TRIAC}$	Application Connector Serial Resistor	TRIAC		0		Ω
I_{OH}	Digital Output Current	Digital outputs except TRIAC TRIAC pin	-2		2	mA
$I_{OH,TRIAC}$	TRIAC Output Current	Only TRIAC output	-8		8	mA
I_{CC}	Transmitting (Xtal: 7.376974 MHz)	-5dBm -2dBm 0dBm +2dBm +3dBm		24 26 28 32 36		mA
	Receiving (Xtal: 7.376974 MHz)			23		mA
	Power Save	RTC running, POR disabled		29		µA
	Power Down	RTC and POR disabled		1		µA

Symbol	Parameter	Condition	Min	Typ	Max	Units
t_{reset}	Input reset pulse		$1024 \cdot f_{clk}$ [1)]			
t_{resetR}	Rise time	10% to 90%			400	µs
t_{resetF}	Fall time	90% to 10%			400	µs
T_{OP}	Operating Temperature		-10		85	°C
H_{OP}	Operating Relative Humidity		8		80	%

(1) When integrated Power On Reset circuitry is enabled min. supply voltage is 2.9V

Table 7 DC Characteristics

4.14 Physical Specification

Physical	Description
Dimension (H x W x D)	8 mm x 21 mm x 30 mm
Shielding	Mounted and connected via two holes (marked A in figure 3) + four edge plated sides (marked B in figure 3).

Table 8 Physical Specifications

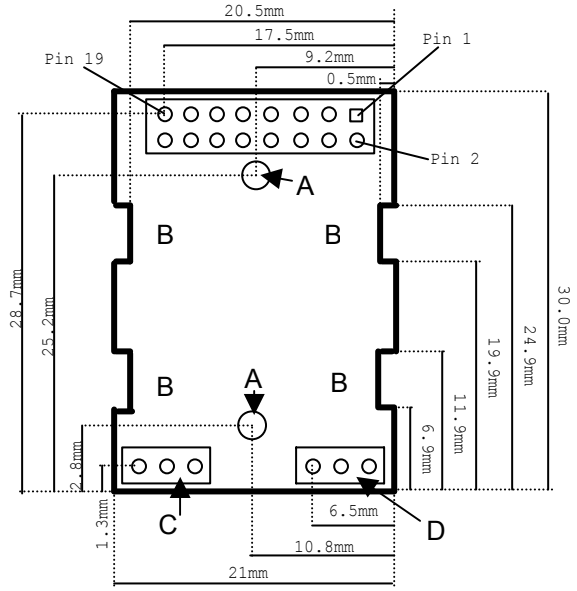


Figure 3 ZM1206 Z-Wave Module PCB outline (TOP VIEW)

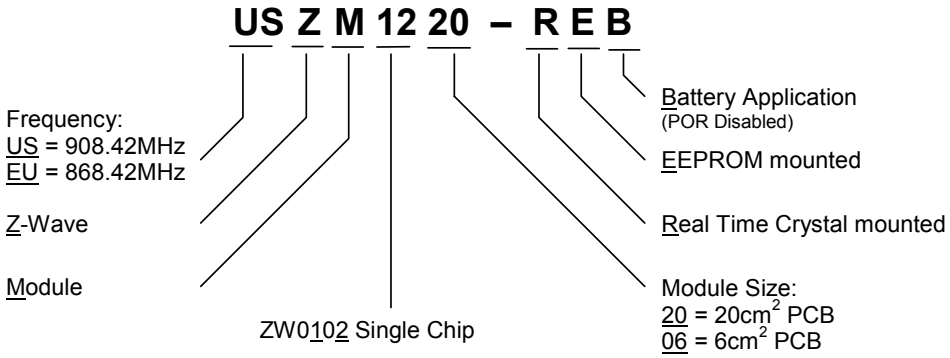
The Application Connector is a standard 2mm pitch 2x8 pin-row. The pad holes (marked as A in figure 3), for supporting and grounding the optional shielding, are Ø0.9mm plated holes. When implementing the ZM1206 Z-Wave Module in a product, together with an Application Module, a 2mm pitch 1x3 pin-row (marked as C in figure 3) can be used for mechanical stability. Another 2mm pitch 1x3 pin row (marked as D in figure 3) can be used to connect the ZM1206 Z-Wave Module to a PCB antenna or a SMA connector on the Application Module.

4.15 Z-Wave Module Component Placement

Figure 2 ZM1206 Z-Wave Module Component Placement

4.16 Module naming:

Explanation of the ZM1206 Z-Wave Module naming.



For more information on the ZM1220 Z-Wave Module see [8].

4.17 ZM1206 Blueprint

The ZW1206 Z-Wave Module has been developed by Zensys A/S and has been extensively tested on both digital signal integrity and RF performances. The Module has been RF/EMC tested and has passed FCC part 15 and R&TTE Directives.

All necessary documentation for pre-production of the ZM1206 Z-Wave Module, including schematics, BOMs, PCB documentation, production test documents, etc. is available as a Blueprint package. This enables OEM customers to reduce time to market of their Z-Wave enabled products. For further information on Blueprint content, please contact Zensys A/S.

5 REFERENCES

A Zensys documentation part number consists of 9 digits where the last two digits refer to the revision of the document. When the revision is listed as “XX” please refer to the latest revision of the document.

[1] Datasheet, ZW0102 Single Chip, Doc. P/N: 9035016XX
[2] Bill-Of-Material, US ZM1206 Z-Wave Module, ZW0102, P/N: 370100411
[3] Bill-Of-Material, EU ZM1206 Z-Wave Module, ZW0102, P/N: 370100431
[4] Z-Wave Node Type Overview and Network Installation Guide, P/N: 9520068XX
[5] Z-Wave ZW0102 Application Programming Guide, P/N: 9002008XX
[6] Datasheet, ZM1206 Converter Module, Model 4904, Doc. P/N: 9035019XX
[7] Func. Prod. Test Doc., ZM1206 Z-Wave Module, P/N: 9530029XX
[8] Datasheet, ZM1220 Z-Wave Module, Doc. P/N: 9035012XX
[9] Schematic, US ZM1206RE POR Enabled, P/N: 9540068xx
[10] Schematic, EU ZM1206RE POR Enabled, P/N: 9540070xx